0022-5282/82/2210-0867$02.00/0
THE JOURNAL OF TRAUMA
Vol. 22, No. 10

Printed in U.S.A.

Improved Survival with Aggressive Surgical Management of Noncandidal Fungal Infections of the Burn Wound

MICHAEL J. SPEBAR, M.D., LTC MC, MICHAEL J. WALTERS, M.D., LTC MC, AND BASIL A. PRUITT, JR, M.D., COL MC

A period of aggressive surgical treatment and early identification of fungal infection of the burn wound was compared with the previous 5 years' experience with patients suffering from fungal infection of burn wounds. The portion of those patients with *Candida* infections diagnosed and treated premortem increased from 48.0% to 63.6% and of patients with noncandidal infections from 40.8% to 67.0% in the more recent period. The mortality of patients with *Candida* infections in 1973 to 1977 was 83.3% and in 1978 was 87.5%. The mortality of noncandidal infections, 87.4% in 1973 to 1977, was 25.0% in 1978. Local surgical control of the infected portion of burn wounds is an effective way of improving the survival in noncandidal burn wound infections. Surgical excision of burn wounds does not alter the poor prognosis of patients with *Candida* invasion of the burn wound.

Infectious complications are the primary cause of death of burn patients following the resuscitation phase. Although most of these infections are bacterial, fungal infections of the burn wound also present a serious problem. This infectious complication is infrequent: however, fungal infections are almost always fatal and are extremely difficult to manage.

An analysis of the experience with this particular infection was reviewed in an attempt to evaluate the efficacy of an aggressive surgical approach to the management of fungal infections of burn wounds.

MATERIALS AND METHODS

All medical records of patients admitted to the U. S. Army Institute of Surgical Research Burn Unit during the years 1973 through 1978 were reviewed. The patients with fungal invasion of the burn wound were selected for study. Criteria described by Spebar in 1979 (4) were used to distinguish colonization of the burn wound from true fungal invasion. Evidence of invasion of viable tissue by the fungal organism was the most important element in the diagnosis of fungal infections.

During the year 1978, an aggressive diagnostic and surgical approach was undertaken. This consisted of burn wound biopsy of any new, darkening areas as described by Pruitt and Foley in 1973 (3). The specimen was then processed for microscopic analysis by the Technicon rapid section technique. A portion of the same specimen was also cultured for bacterial and fungal organisms.

If fungal elements were visualized in viable tissue, a wide surgical excision of this area was undertaken down to the underlying muscle fascia with a peripheral margin of 3 to 5 cm. The surgical specimen was cultured for bacteria and fungal organisms and the margins of the specimen were examined microscopially for residual fungal invasion. No topical antifungal agents were used. Intravenous amphotericin-B was reserved for patients with multifocal, systemic, or muscle invasion by fungi.

Fungal infections were arbitrarily divided between *Candida* and noncandidal infections. The mortality of those suffering these infections during the year 1978 were then compared with the patients who suffered similar infections in the years 1973 through 1977. Attention was focused on the patients in whom the diagnosis was made antemortem and treatment instituted.

RESULTS

One thousand five hundred thirteen patients were admitted to the U. S. Army Institute of Surgical Research Burn Unit during this time period. One hundred eighteen (8.2%) of these developed a fungal infection of the burn wound. *Candida* invasion was responsible for 38.5% of these infections. The remaining 61.5% were due to noncandidal fungal organisms, primarily *Fusarium*, *Aspergillus*, and the phycomycetes.

During the period 1973 through 1977, 48.0% of the

From the U. S. Army Institute of Surgical Research, Brooke Army Medical Center, Fort Sam Houston, Texas.

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army of the Department of Defense.

Presented at the Fourteenth Annual Meeting of the American Burn Association, Boston, Massachusetts, May 13-15, 1982.

Address for reprints: Library, U. S. Army Institute of Surgical Research, Fort Sam Houston, TX 78234.

patients with *Candida* infections and 40.8% of those with noncandidal fungal infections were diagnosed premortem. This compares with 63.6% of those with *Candida* infections and 67.0% of patients with noncandidal infections diagnosed premortem and treated during the 1978 study period.

Table I summarizes the mortality of fungal infections during the study year compared to the control period. No patients survived a noncandidal fungal infection if the organism had invaded the muscle or its fascia or was present in more than one area of the body.

TABLE I
Mortality of burn patients with fungal infections diagnosed premortem and treated

	1973-1977	1978
Candida	83.3%	87.5%
Noncandidal	87.4%	25.0%

DISCUSSION

The burn wound can be colonized by a variety of microorganisms including fungi. An infection occurs when circumstances permit these colonizing organisms to invade viable tissue beneath the eschar. Fungal infections of the burn wound are generally insidious, more lethal, and more difficult to treat than bacterial infections (1). Frequently, they are only diagnosed on postmortem examination. This is especially important because it is only when the infection is discovered in its early phase, with superficial invasion of viable tissue confined to one area of the body, that it can be successfully managed. Infection, discovered and treated early in its pathogenesis, accounts for the observation that the mortality was less in those patients with noncandidal infection during the study year 1978.

This also explains why there was no change in the mortality of patients with *Candida* infections. *Candida* usually invades the burn wound following a long period of colonization and is usually a preterminal event, when the patient's host defense mechanisms have totally collapsed (5). By their very pathogenesis, *Candida* infections are never discovered when they are lo alized to a discrete area of the burn wound, amenable to surgical excision.

It is apparent from this study that if the fungal infection can be recognized and surgically excised, the mortality can be sharply reduced. The infection usually appears as a dark area of the burn wound with a sunken appearance, similar to ecthyma gangrenosa (2). Frequent examination of the burn wound by the same trained observer is important. This point has been emphasized in the early diagnosis of bacterial infections and applies equally to fungal infections of the burn wound. At this point in the pathogenesis of noncandidal infections, the infection is a local phenomenon that responds well to a local excision. For this reason, systemic antifungal agents were not used in this instance and were employed only when the infection itself was systemic and beyond the control of surgical excision.

Wide surgical excision of the infected areas of the burn wound before the development of the grave signs of deep or multicentric invasion can improve survival of patients with noncandidal infections of the burn wound. *Candida* infections of the burn wound, however, do not respond to the same therapeutic regimen.

REFERENCES

1. Bruck, H. M., Nash, G., Pruitt, B. A.: Opportunistic fungal infections of the burn wound with phycomycetes and *Aspergillus*. *Arch. Surg.*, **102:** 476-482, 1971.
2. Dorff, G. J., Geimer, N. F., Rosenthal, D. R.: Pseudomonas septicemia, illustrated evaluation of its skin lesion. *Arch. Intern. Med.*, **128:** 591-595, 1971.
3. Pruitt, B. A., Foley, F. D.: The uses of biopsies in burn patient care. *Surgery*, **73:** 887-897, 1973.
4. Spebar, M. J., Lindberg, R. B.: Fungal infection of the burn wound. *Am. J. Surg.*, **138:** 879-882, 1979.
5. Spebar, M. J., Pruitt, B. A.: Candidiasis in the burned patient. *J. Trauma*, **21:** 237-239, 1981.